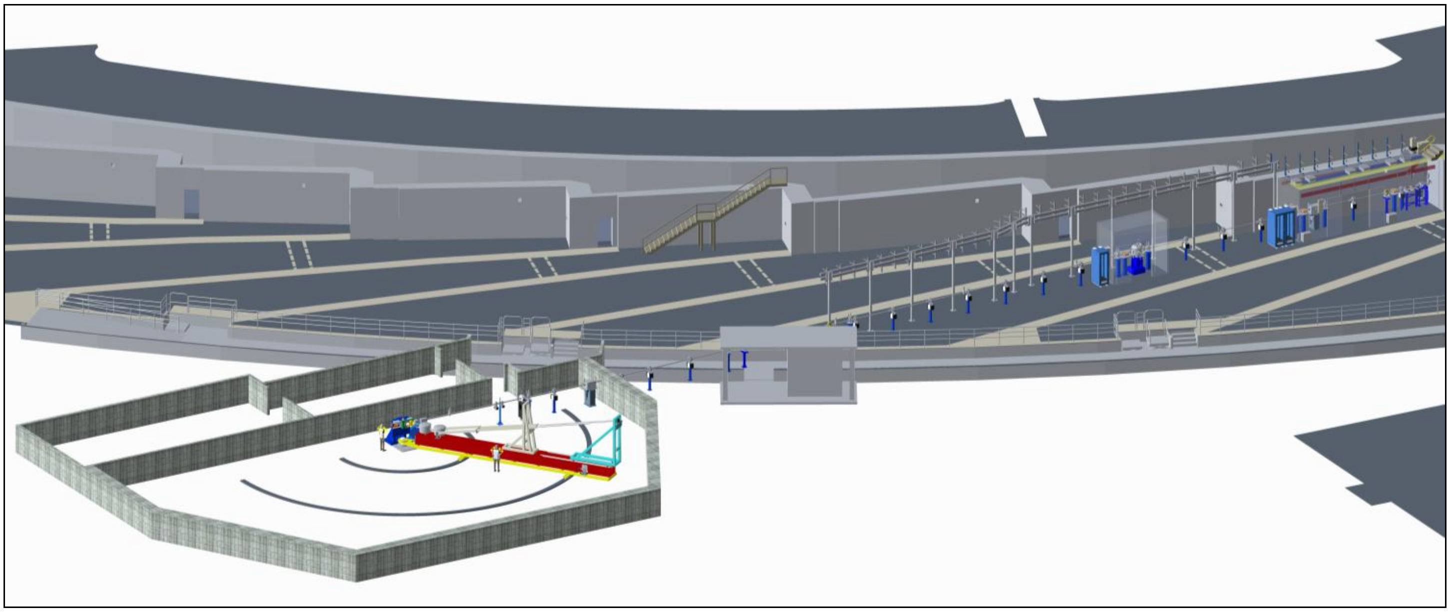
NSLS-II EXperimental Tools (NEXT)

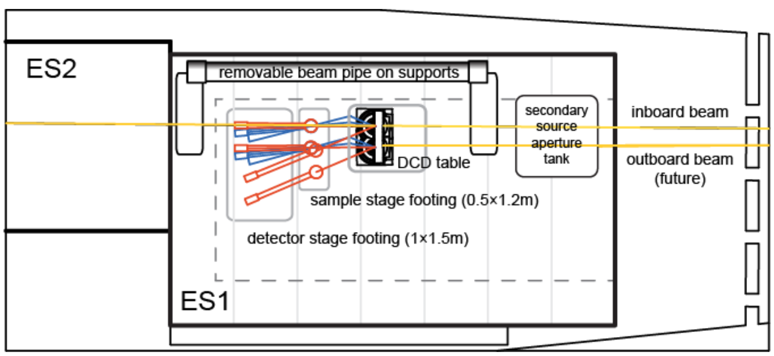
Progress Report

July 2012

Each month, graphics related to three of the six NEXT beamlines are shown below and discussed in the reports.



3D layout of the SIX beamline and spectrometer.



Liquids Endstation layout of SMI, showing initial and future placement on shared and canted beam

Layout of the ISR experimental hutches.

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OVERALL ASSESSMENT

The NSLS-II Experimental Tools (NEXT) Project made excellent progress on preliminary design and formulation of the associated cost and schedule plan. Project management documents are being finalized and various management processes and procedures are now in place. The Preliminary Design Report (PDR) is being finalized and the project is on its path to complete all Critical Decision-2 (CD-2) requirements well before the upcoming DOE Office of Project Assessment (OPA) Review scheduled for September 11-13.

The proposed project baseline scope and associated cost and schedule cover the design of six beamlines and the construction of five beamlines. The proposed total project cost (TPC) of $90M includes $67.1M Budget At Completion (BAC) and 31% contingency, values that have been slightly refined since the June report. The proposed early project completion date remains Sept. 2016, and the CD-4 milestone is Sept. 2017.

A team of external technical experts, appointed by the Associate Laboratory Director for Photon Sciences, will be conducting a design review of the PDR on August 7-9. The PDR will be finalized after incorporating advice and recommendations from this external design review.

The Earned Value Management System (EVMS) tracking of NEXT cost and schedule systems began with the May 2012 data as an internal exercise to prepare the NEXT Cost Account Managers (CAMs) for official EVMS reporting, which will commence following the DOE CD-2 Review. We expect to include a Cost Performance Report with the report due in October, covering activity through September.

The search for a fifth mechanical engineer is underway. One interview has been scheduled. Beamline Advisory Team (BAT) meetings for the ESM and SIX beamlines are being scheduled for October 2012.

ESM – ELECTRON SPECTRO-MICROSCOPY

Refining the preliminary design of the ESM beamline has been this month's main priority. Particularly, a close look at the power load imposed on the optics by the EPU105 undulator was given. The Finite Element Analysis (FEA) calculations simulating the worst scenario for the water-cooled first mirror of the ESM–WEL line (M1-WEL) indicate a negligible spherical deformation in the meridional direction (R ~300 km) and a more sizable spherical deformation (R ~260 m) in the sagittal direction (Fig. 1). These results are encouraging, indicating that conventional water cooling is adequate for this mirror. The sagittal deformation can be fully corrected by taking advantage of the focusing properties of the VLS monochromator.

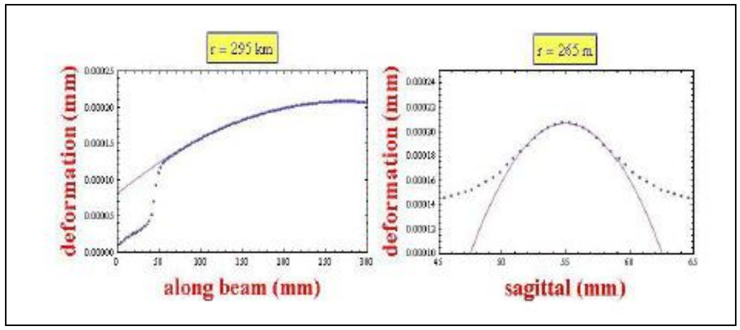


Figure 1. Dots: Deformed profiles of the ESM M1-WEL plane mirror in the meridional (left) and sagittal (right) directions under the heat power generated by the EPU105 undulator tuned at 15 eV and linear horizontal polarization. Perfect circles (continous lines) accurately reproduce the central part of the "heat bump" deformation.

FXI – FULL-FIELD X-RAY IMAGING

The first FEA results were obtained for the collimating mirror and double crystal monochromator under thermal loads. The results confirm that the thermal loads can be managed. Detailed layout of the FOE has begun.

SIX – SOFT INELASTIC X-RAY

Three analyses related to the beamline optical scheme were carried out. First, the heat bump deformation on the beamline's first mirror (Fig. 2) and the grating were simulated by FEA. Second, the ray tracing analysis was updated to include thermally induced deformations of the optical elements. Third, the mechanical tolerances for the optical components of the beamline were estimated.

Regarding the spectrometer, the team has begun mechanical engineering of a thermal insulation enclosure for the 15m-radius arm, with a targeted thermal stability of ± 0.05°C. Preliminary discussions regarding mechanical design of this enclosure and the type of temperature controller needed to achieve this stability are underway.

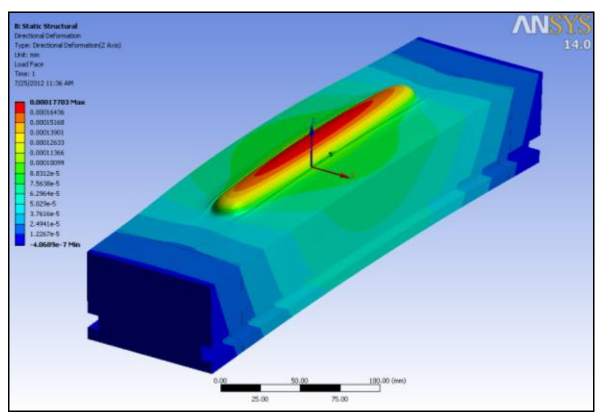


Figure 2. Thermally-induced deformation of the first mirror in the SIX beamline as determined by Finite Element Analysis.

ISS – INNER SHELL SPECTROSCOPY

Following the investigations on the heat load–induced deformation of the first monochromator crystal, the influence of this deformation on the beam quality was studied at the focal spot of the toroidal mirror. Assuming illumination by the full length of the DW100 source and the various simulated deformations for the proposed operational conditions, we were able to verify by ray tracing that the vertical beam dimension is maximally increased by 500 µm. The horizontal increase is fully negligible. The resulting beam is nearly spherical with a diameter of 1 mm. Neither intensity nor beamsize in the focal spot after the poly capillary system will be influenced by this beam size increase. This result demonstrates that the proposed optics is very forgiving, supporting user-friendly operation over the proposed energy range of the beamline.

A second effort was devoted to defining specifications of the endstation hutch and its instrumentation. In addition to a preliminary design of the gas handling system, shown in Figure 3, a design of the analyzer detection system was finalized along with associated cost estimate and a risk mitigation plan.

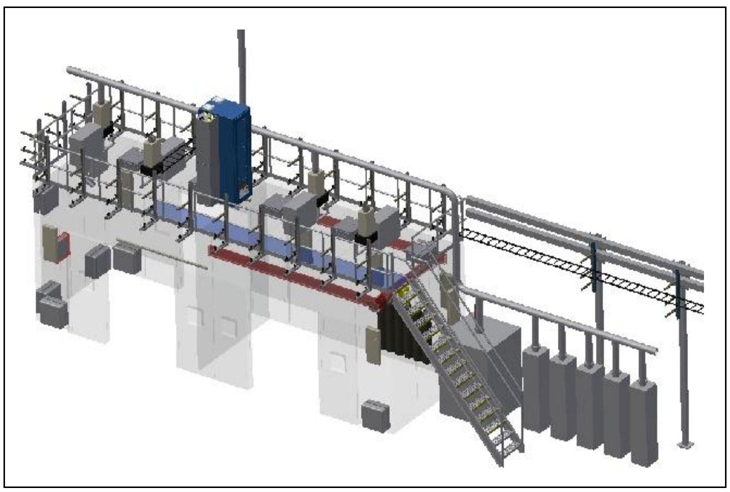


Figure 3: Planned infrastructure of the endstation hutch of ISS. The safety vent system shown here will be connected to the Hazardous Gas Cabinets, a centralized gas-handling facility housing all gas distribution, gas flow, and gas purification instrumentation, and the reactor vent. All gas lines will be welded according to national, state/local, and BNL safety standards.

SMI – SOFT MATTER INTERFACES

Optical calculations took center stage in order to refine performance targets and to determines the technical means necessary to achieve them (Fig. 4). The phase space analyses show that SMI's secondary focus scheme to achieve micron spot size in the far endstation also achieves good primary focus in the near endstation, with no adjustment needed between the two configurations. As a result of this process, the Liquids Endstation layout (cover image) was finalized.

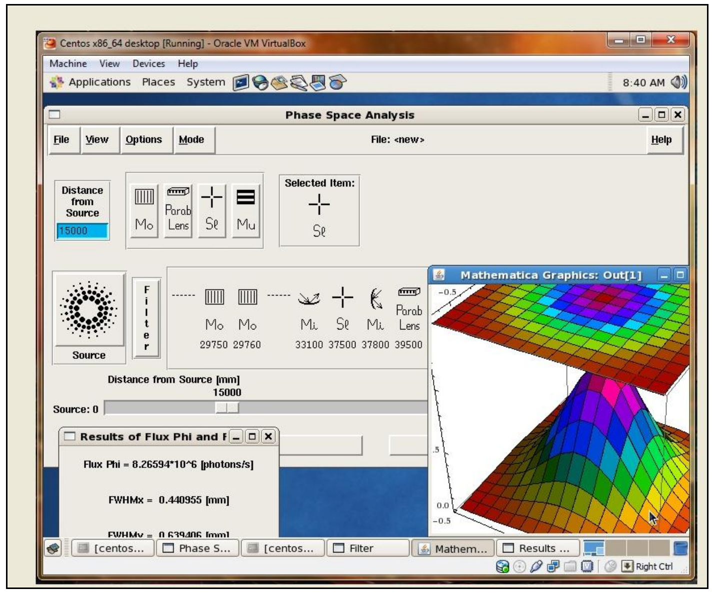


Figure 4. Phase space analysis software being used to assess spatial, angular, and wavelength acceptances of photon delivery system for SMI.

ISR – IN-SITU AND RESONANT HARD X-RAY

The layout of the ISR experimental hutches, including control stations for each, was refined, and is shown in Fig. 5. The magnet and 4-circle endstations are in the upstream hutch, and the secondary focusing KB mirrors and in-situ diffractometer are in the downstream hutch. A first iteration of finite element analysis calculations of direct and indirect cooling of the first two ISR optics—the horizontal focusing mirror and double-crystal monochromator—were completed, and are being evaluated.

Figure 5. Layout of the ISR experimental hutches.

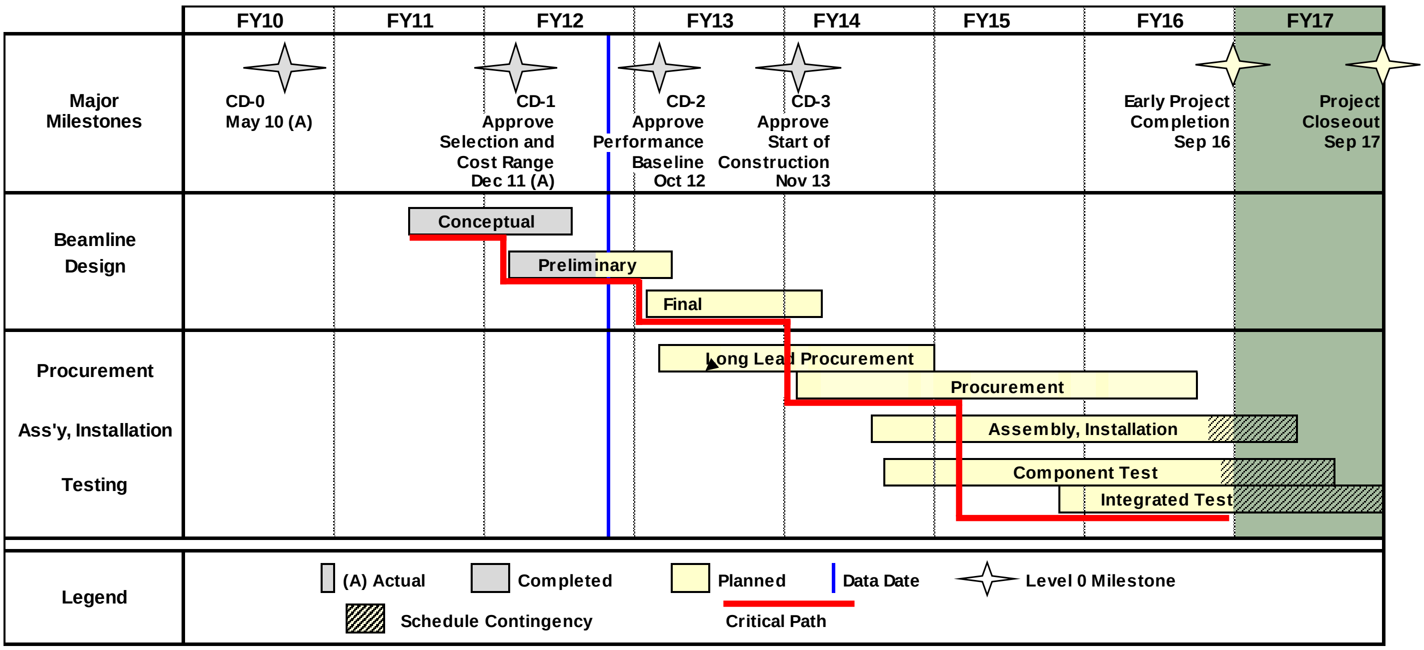
PROJECT MILESTONES

CD-0 (Mission Need):	Planned: 3Q10	Actual: May 27, 2010
CD-1 (Alternative Selection):	Planned: 4Q11	Actual: Dec. 19, 2011
CD-2 (Performance Baseline):	Planned: 1Q13	
CD-3 (Start Construction):	Planned: 4Q13	
Early Project Completion:	Planned: 4Q16	
CD-4 (Project Completion):	Planned: 4Q17	

UPCOMING EVENTS

ALD's Preliminary Design Report (PDR) Review	Aug 7–9
DOE CD-2 Review of NEXT Project	Sep 11–13
ESM Beamline Advisory Team (BAT) Meeting	Oct TBD
SIX BAT Meeting	Oct TBD

PROJECT SCHEDULE



Funding Profile

Funding Type	NEXT Funding Profile ($M)						
	FY11	FY12	FY13	FY14	FY15	FY16	TOTAL
OPC	3.0						3.0
TEC		12.0	12.0	25.9	21.6	15.5	87.0
Total Project Cost	3.0	12.0	12.0	25.9	21.6	15.5	90.0

Cost and Staffing Report

	Current Period		Cumulative-to-date	
As of 5/31/2012	Planned*	Actual	Planned*	Actual
Cost	–	$243,734	–	$2,597,408
Staffing (FTE-year)	–	1.31	–	11.41

*Planned values will be included once EVMS tracking has begun.

Key Personnel

Title	Name	Email	Phone
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Glossary of Acronyms

2D, 3D	two-dimensional, three-dimensional
AC-PEEM	Aberration Corrected PEEM
ALD	Associate Laboratory Director
APS	Advanced Photon Source
AP-SPEM	Ambient Pressure SPEM
ARPES	Angle-Resolved PhotoElectron Spectroscopy
BAC	Budget At Completion
BAT	Beamline Advisory Team
CAM	Cost Account Manager
CCD	Charge Coupled Device
CRL	Compound Refractive Lens
DW	Damping Wiggler
EPU	Elliptically Polarized Undulator
ESM	Electron Spectro-Microscopy Beamline
EVMS	Earned Value Management System
FEA	Finite Element Analysis
FOE	First Optics Enclosure
FXI	Full-field X-ray Imaging (beamline)
GISAXS	Grazing Incidence SAXS
ISR	Integrated In-Situ & Resonant X-Ray Studies (beamline)
ISS	Inner Shell Spectroscopy (beamline)
IVU	In-Vacuum Undulator
μ-ARPES	micro ARPES
OPA	Office of Project Assessment
PCR	Project Change Request
PDR	Preliminary Design Report (or Review)
PEEM	PhotoElectron Emission Microscopy
PPS	Personnel Protection System
SAXS	Small Angle X-ray Scattering
SIX	Soft Inelastic X-ray Scattering (beamline)
SMI	Soft Matter Interfaces (beamline)
SOE	Second Optics Enclosure
SPEM	Scanning PhotoElectron Microscopy
TPC	Total Project Cost
TXM	Transmission X-ray Microscope
VLS	Variable Line Spacing